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BY

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# MINING METHODS AND COSTS AT THE MINE OF THE ST. JOSEPH LEAD CO., ATLANTA, IDAHO[1]

By E. D. Gardner[2]

## INTRODUCTION

This paper is one of a series on mining methods and costs being published by the United States Bureau of Mines.

In April 1934 the St. Joseph Lead Co., at Atlanta, Elmore County, Idaho, was mining and milling about 225 tons of gold ore daily with a total force of 150 men. The mine, which comprises the old Boise-Rochester and Monarch properties, is at an elevation of about 6,000 feet. Snow lies on the ground about 5 months each year but does not interfere greatly with local operations. However, the road to Mountain Home, the shipping point 80 miles distant, passes over a high range and usually is closed by snow from about November 15 to June 15. Heavy supplies are brought in and concentrates trucked out during the summer. In winter the district is served by a biweekly mail plane and a passenger and express plane making 4 to 6 trips weekly. Mine timber is cut locally. A plentiful supply of water is obtained from a stream brought to the property through 7,500 feet of plume.

## ACKNOWLEDGMENTS

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## HISTORY

Atlanta is one of the early mining districts in Idaho. Mining operations have been carried on intermittently since ore was discovered in 1864. At one time Atlanta was one of the principal districts in the State; many millions of dollars in gold and silver have been produced in the district. The property now held by the St. Joseph Lead Co. was worked last in 1917 before this company entered the field.

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[1] The Bureau of Mines will welcome reprinting of this paper, provided the following footnote acknowledgment is used: "Reprinted from U. S. Bureau of Mines Information Circular 6823."

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The Boise-Rochester mine, which is now being operated, was opened by early operators with two drifts from the surface. The ore was taken to an amalgamation and gravity-concentration mill by an aerial tramway. The present company built a new amalgamation and flotation mill and ran a crosscut haulage level to the lode at the level of the mill 300 feet below the old workings. The company began operations on the ground August 18, 1931; the air compressor was started November 16, 1931 and the mill, February 1, 1932.

The development of flotation for gold ores during recent years has made possible a much higher recovery of gold and silver than was possible in the old amalgamation and gravity-concentration mill. Ores now can be mined that could not be worked profitably under the old conditions.

The St. Joseph Lead Co. was the largest producer of gold in Idaho in 1933; about 28.5 percent of the total production of the State was from this mine.

## GEOLOGY

The ore occurs in the Atlanta lode; this is a shear zone 50 to 120 feet wide, at or near a contact of two granites of different ages. The lode is confined wholly to the older rock and has well-defined walls. The material in the shear zone is fractured and partly decomposed granite with minor quantities of quartz and calcite.

The ore occurs as lenses ranging from 4 inches to 40 feet wide and up to 360 feet long on the strike; the principal ore shoot has been followed for 600 feet on the dip. The orebodies occur on the footwall, near the hanging wall, or within the lode. The dip of the orebody being worked in May 1934 was 72° to 85°.

The ore consists of dark-colored quartz containing disseminated fine crystals of arsenopyrite, pyrite, and argentite. Pyrite which is generally barren is abundant in places. The gold occurs free and with the sulphides. The ore as it went to the mill in the spring of 1934 ranged from 0.3 to 0.5 ounce of gold and 0.75 to 3.00 ounces of silver per ton; the quartz streaks, however, were much higher in grade. There is no line of demarcation between the ore and the other lode material; in most places close sampling and assaying are necessary to determine the ore limits.

The ground within the lode although dry is very heavy and swells upon exposure to the air. Permanent openings within the lode are held open with difficulty; haulage drifts are run in the hanging wall. Close filling is required in the stopes. When a cut of ore is taken in a stope there is a tendency for blocks of vein material parallel to the ore to push into the opening.

The vein is prospected by running crosscuts every 100 feet from the drifts in the hanging wall. Seams of dark-colored quartz are followed by drifting and raising. Occasionally these seams widen out into orebodies. All new faces are sampled.

## MINE EQUIPMENT

A completely new surface plant including buildings was constructed by the present company.

As the quantity of ore developed did not indicate a long life for the mine, equipment (except the power plant) was moved in from other properties of the company that were temporarily idle because of the low prices of base metals.

The mine equipment consists of the following: One 970-cubic-foot, 20-drill, two-stage, 19- by 11- by 14-inch Ingersoll-Rand XRE air compressor, driven by a direct-connected, 175-hp. motor running at 257 r.p.m.; two 1 1/2-ton Mancha storage-battery locomotives; one 20-kva generator for charging batteries; 4 extra batteries; forty 17-cubic-foot, 0.9-ton mine cars; 1 no. 50 Ingersoll-Rand drill sharpener; 15 to 20 Ingersoll-Rand CC stopers; 4 drifters; 7 jackhammers; and hand and miscellaneous tools.

### Power Plant

Power for the mine, mill, and camp site is supplied mainly by a 360-hp., 8-cylinder, German-submarine, Diesel engine, direct-connected to a three-phase, 480-volt, 375 kva generator. A hydroelectric plant that generates from 40 to 125 hp., depending upon the water supply, is situated about 2 1/2 miles from the mine. The power from the two sources is synchronized at the Diesel plant.

## DEVELOPMENT

The mine is developed by a haulage adit on the 900 level and a working adit on the 600 level. The main production of ore is from about the 600 level. Drifts are run midway between the main levels for prospecting and stoping the ore. The ore is drawn from chutes on the 600 level and trammed to a transfer raise to the 900 level, whence it is taken to the mill. The men enter the mine on the 600 level and are hoisted to the upper levels; the steel-sharpening and blacksmith shop, at which 200 pieces of steel are sharpened daily, is on this level. Supplies for the mine are taken by motor through the 600 level and hoisted through a vertical raise, extending 400 feet from the 600 to the 250 level.

### Raises

Development raises are 3 feet 6 inches by 7 feet outside measurement; they are divided in the middle to make two compartments. Raise sets are placed on 5-foot centers. The raise timbers are framed in a shed equipped with planer, and cut-off, and band saws.

Raise rounds consist of an average of twelve 5-foot holes. The raises are run for a contract price of $4 per foot for labor and explosives. The company furnishes compressed air, timber, and other supplies and hauls the muck from the bottom of the raise. A raise crew usually consists of 3 men on each of 2 shifts; occasionally, however, 2 men on each of 2 shifts comprise a crew.

## Drifts

Drifts are run 5 by 7 feet in section. Drift rounds in granite consist of an average of 12 holes that break about 5 feet. A downward toe-cut hole round is drilled.

Drilling and crosscutting in the spring of 1934 were done at a contract price of $5 per foot for labor and explosives. The contractors also laid the track and put in the air lines as a part of the contract. The broken rock was trammed by hand to a switch not over 600 feet away. A drift crew consisted of 1 driller on one shift and 2 shovelers on another.

Drift sets in the crosscuts are placed on 5-foot centers by company timbermen.

## STOPING

A horizontal cut-and-fill is the principal method of stoping; in wide sections of the vein the stopes are square-setted. Square-set sections are 15 to 40 feet wide. Cuts in the cut-and-fill stopes are 3 to 4 1/2 feet high. These stopes are carried up the width of the ore where it is 4 feet or more in thickness. Where the ore is less than 4 feet thick it is first broken and removed, then enough waste is shot down to provide filling. The thickness of the ore ranges from 3 to 40 feet.

The ore is shot down on 2-inch plank floors and shoveled into the chutes. Coarse waste is sorted out of the ore by the shovelers. The floors are taken up before filling.

Drilling is done with stopers. In wide stopes vertical holes are drilled 3 1/2 feet apart in two rows also 3 1/2 feet apart. A round consists of 12 to 20 holes. In breaking narrow streaks of ore in hard ground the holes are drilled 1 foot apart and staggered; they are shot with one stick of 30-percent-strength gelatin to the foot of the hole.

As the stoping progresses upward the regular manway and chute raises are carried up the fill on 40-foot centers. They are built up 5 feet at a time. One compartment is used for an ore chute and the other for a manway and timber slide. Timber and other supplies are hoisted and lowered to the stopes through these raises by means of Little Tugger hoists. A hoist is sometimes set at the bottom of a raise and the sheave attached to a tripod or stull over the timber slide, and at other times the hoist is on a truck on the level above.

Side blocks of vein material that tend to fall in the stope are supported largely by waste filling that is run into the stope as soon as a cut is completed. In wide cut-and-fill stopes the back requires some auxiliary support until the space is filled. Casual stulls, both from the filling to loose blocks in the back and between walls of the stope, are placed as required. The backs of narrow stopes stand well.

In wide, filled stopes filling is obtained from inclined waste raises run across the lode in each section midway between the chute raises. These raises are in effect channels or inclined shrinkage stopes across the shear zone. Most of the orebodies occur on the footwall; hence in these sections the raises are run toward the hanging wall. Where the ore is on the hanging wall the raises are run toward the footwall. Where the ore is over 7 feet wide an extra waste raise is run in each section. The waste is leveled in the stopes by hand. It is allowed to pile up in the raises and drawn as needed.

The waste raises have prospecting value. Any seams of dark-colored quartz are followed; occasionally orebodies are found in this manner. The waste workings do not appear to cause weight in the stopes. In narrow stopes enough waste is broken during stoping to provide the necessary filling. The mine was originally laid out in such a manner that development waste could rarely be used as filling; this condition, however, has been overcome. Now, raises are usually extended between levels ahead of stoping.

In long stopes some of the 46-foot sections between raises are of different heights; where this is the case dry walls are built with coarse waste at the end of the sections to retain the filling.

The ore from the different stopes is drawn in a predetermined proportion and mixed to keep the mill heads as uniform as practicable.

## TRAMMING

Tramming on the 900 and 600 levels is done by two 1 1/2-ton, Mancha, storage-battery locomotives. An extra battery is used for each locomotive. The charging stations are at the portal of the adits. The motor-generator set is in the engine house.

An ore train consists of 9 side-dump cars which hold 0.9 ton each. The track gage is 18 inches; 16-pound rails are used on the 900 level and 12-pound ones on the 600 level. Tramming is done by hand on the intermediate levels.

## VENTILATION

The mine is naturally ventilated; rock temperatures are relatively low. The two main adits are outcast during the winter. The workings are connected with a shaft at the other end of the mine. The air appears good in stopes where the only connections are to a level 325 feet below. Definite currents travel up some of the manways and down others; they are controlled by doors at various places on the 600 level.

## LABOR

The wage scale is miners, $5.00; muckers, $4.50; and shift boss, $5.50. The average daily force for mine, mill, and surface in April 1934 was as follows:

| | |
|---|---|
| Mine | 105 |
| Mill | 18 |
| Surface (shops, power house, teamsters, etc.) | 19 |
| Engineers and assayer | 3 |
| Office and warehouse | 5 |
| Total | 150 |

## COSTS

The cost of explosives at the mine is as follows:

| | | |
|---|---|---|
| 30-percent-strength gelatin dynamite | per pound | $0.128 |
| Fuse | per foot | .014 |
| Caps | each | .0115 |

The amount and cost of development work in April 1934 is shown in table 1.

The drifts are 5 feet 4 inches wide at the cap by 6 feet 4 inches high in the clear. The raises have three compartments and are 4 feet 8 inches by 10 feet 8 inches in the clear. All drifts and raises are timbered with 8- by 8-inch timber on 5-foot centers; the timber costs $25 per 1,000 board-feet.

In 1932 the cost of drifts and crosscuts was $7.78 and that of two-compartment raises $8.19 per foot.

Stoping costs are shown in table 2 and total cost per ton in table 3. The tonnage produced per man-shift is shown in table 4.

TABLE 1. - Cost of development work in April 1934

| | Drifts (138 feet) | Raises (184.3 feet) |
|---|---|---|
| Labor | $4.93 | $4.50 |
| Supplies | 1.537 | 2.86 |
| Power | .24 | .21 |
| Total direct cost | 6.707 | 7.57 |

### TABLE 2. - Stoping costs in April 1934[1]

(6,174 tons)

| | Labor | Supplies | Power | Total |
|---|---|---|---|---|
| Drilling ................ | $0.73 | 2/$0.308 | $0.10 | $1.138 |
| Shoveling ............... | .65 | .005 | ....... | .655 |
| Timbering ............... | .35 | .304 | ....... | .654 |
| Haulage ................. | .17 | .035 | .037 | .242 |
| Miscellaneous ........... | .05 | ...... | .006 | .056 |
| Supervision ............. | .13 | ...... | ....... | .13 |
| Total ............... | 2.08 | 0.652 | 0.143 | 2.875 |

1/ Includes filling and waste raises; does not include manager, general superintendent, assayer, general office, engineering, warehouse, village expenses, or taxes.

2/ Drill supplies, $0.063; explosives, fuse, and caps, $0.245.

### TABLE 3. - Total costs per ton in April 1934

| | |
|---|---|
| Development ......................................... | $0.272 |
| Stoping and transportation .......................... | 2.797 |
| Overhead and miscellaneous .......................... | .763 |
| Milling ............................................. | 1.336 |
| Total ........................................... | 5.198 |

### TABLE 4. - Output per man-shift in April 1934

| | Tons per man-shift |
|---|---|
| Miners, stoping ........................... | 7.86 |
| Shovelers ................................. | 8.11 |
| Miscellaneous underground (4 shift bosses, track and pipe men, etc.)...... | 9.32 |
| Total underground ......................... | 2.60 |
| Total all men ............................. | 1.55 |
| | Pounds per ton |
| Explosives for stoping and filling ......... | 0.148 |